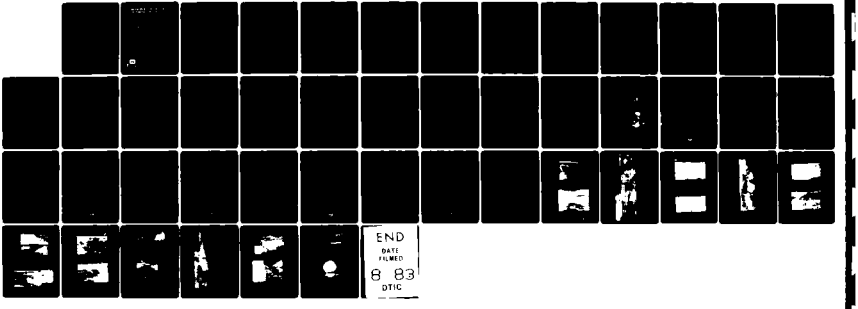
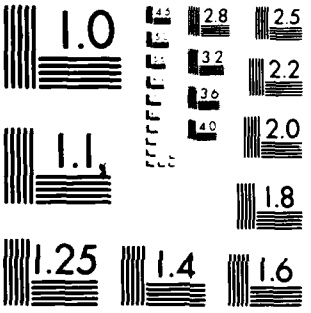
AD-A130 898 EMBANKMENT CRITERIA AND PERFORMANCE REPORT CHEYENNE RIVER BASIN SOUTH DAK..(U) ARMY ENGINEER DISTRICT OMAHA NEBR JAN 83 1/1

UNCLASSIFIED F/G 13/13 NL





EMBANKMENT CRITERIA AND PERFORMANCE REPORT

January 1983

Cheyenne River Basin, South Dakota

CEDAR CANYON DAM
RAPID CITY, SOUTH DAKOTA

PROJ C7166
DISK 455C

CHEYENNE RIVER BASIN, SOUTH DAKOTA
RED DALE GULCH AREA
CEDAR CANYON DAM

EMBANKMENT CRITERIA AND PERFORMANCE REPORT

U.S. ARMY ENGINEER DISTRICT, OMAHA
CORPS OF ENGINEERS
OMAHA, NEBRASKA

CHEYENNE RIVER BASIN, SOUTH DAKOTA
RED DALE GULCH AREA
CEDAR CANYON DAM
EMBANKMENT CRITERIA AND PERFORMANCE REPORT

TABLE OF CONTENTS

TABLE OF CONTENTS (CONT'D)

APPENDIX A - DRAWINGS

NOTE: Many of the Plates used are the original Construction Plates and contain notes referring to the construction of the dam.

APPENDIX B - PHOTOGRAPHS

Plate No.	Photo No.	Description
B1	1	View of test trench no. 2 - shows borrow material used for compacted fill.
	2	View of the crest of the embankment looking towards the left abutment.
B2	3	Panoramic view of the upstream slope of the embankment.
B3	4	View of the upstream slope of the embankment looking towards the left abutment.
	5	View of the usptream slope of the embankment looking towards the right abutment.
B4	6	Panoramic view of the downstream slope of the embankment.
B5	7	View of rock slope protection on the upstream face of the dam.
	8	View of rock slope protection on the downstream face of the dam.
B6	9	View of embankment during construction.
	10	View of borrow area during construction of the dam. (Embankment is shown on right hand side of photo.)
B7	11	View of the emergency spillway looking upstream.
	12	View of the emergency spillway looking downstream.
B8	13	View of outfall channel (natural terrain) below the emergency spillway.
	14	View of the emergency spillway channel relative to the embankment.
B9	15	Panoramic view of the right excavated side slope of the emergency spillway.
B10	16	View of the conduit inlet headwall and trashrack structure.
	17	View of the outfall channel below the downstream terminus of the conduit.
B11	18	View of downstream terminus of the conduit.
	19	View looking up the conduit towards the reservoir area.

PERTINENT DATA

CEDAR CANYON DAM

1. RESERVOIR AND HYDROLOGICAL DATA.

Drainage Area Controlled	261 acres
Peak Inflow - SPF at damsite	1,120 c.f.s. (design flood)
Peak Inflow - MPF at damsite	2,860 c.f.s.

PERTINENT STORAGE LEVELS

Feature	Elevation (ft. m.s.l.)	Storage (acre-feet)	Area (acres)
Top of Dam	3554.0	268	18.5
Maximum Probable Flood (MPF)	3550.6	210	15.0
Standard Project Flood (SPF)	3545.5	155	11.5
Spillway Crest	3545.0	136	11.0
Sediment Allowance	3528.2	20	3.3
Outlet Works Invert	3526.0	13	2.7

2. EMBANKMENT.

Type	Compacted homogeneous earthfill
Crest Elevation	3554.0 feet m.s.l.
Maximum Height Above Flood Plain (No discernible channel)	42 feet

Crest Width	15 feet
Crest Length	1,320 feet
Slope Protection	Riprap (both faces of embankment)
Side Slopes	Symmetrical 1V on 3H
Compacted Fill Quantities	Approximately 139,200 cubic yards

3. SPILLWAY.

Type	Uncontrolled-excavated in Minnekahta Limestone Bedrock
Location	Right abutment of dam
Crest Elevation	3554.0 feet m.s.l.
Width	60 feet
Length	650 feet
Discharge Capacity (MPF)	1,750 c.f.s. at El. 3550.6 feet m.s.l.
Slopes	See Section 6, pg. 9

4. OUTLET WORKS.

Type	Uncontrolled
Intake Structure	Cast in place, reinforced concrete slab and headwall with galvanized trash racks

4. OUTLET WORKS (CONT'D)

Invert Elevation of Intake	3526.0 feet m.s.l.
Invert Elevation of Outlet	3516.0 feet m.s.l.
Conduit	24" CMP, bituminous coated
Conduit Length	230 feet
Design Capacity Discharge (SPF)	49 c.f.s. at El. 3545.5 feet m.s.l.
Outlet Channel	Excavated rock

5. DOWNSTREAM DISCHARGES. Cedar Canyon Dam was not designed for permanent storage of water but only as a detention structure with the capacity to reduce peak discharges for floods of all magnitudes. Under full operating conditions the standard project flood will be completely discharged in 5 days if no additional inflow is received.

6. REFERENCES. For additional information and description on the construction background, operational data, or procedures regarding this dam, reference is made to "Periodic Inspection Reports Nos. 1, 2, and 3," dated May 1970, September 1975, and September 1980, respectively; "Operation and Maintenance Manual," dated December 1981; and "Plans and Specifications for Cedar Canyon Dam," dated April 1959.

CHEYENNE RIVER BASIN, SOUTH DAKOTA

RED DALE GULCH AREA

CEDAR CANYON DAM

EMBANKMENT CRITERIA AND PERFORMANCE REPORT

1. INTRODUCTION.

1.1. PURPOSE OF REPORT. This report provides a summary record of significant design, construction, and operational data on Cedar Canyon Dam for use by engineers to familiarize themselves with the project, re-evaluate the embankment when unsatisfactory performance occurs, and provide guidance for designing comparable future projects. It was prepared in accordance with MRD-R 1110-1-8, subject; "Construction Foundation Reports and Embankment Criteria and Performance Reports," dated 27 February 1978, and ER 1110-2-1901, subject: "Embankment Criteria and Performance Reports," dated 31 December 1981.

1.2. AUTHORIZATION AND PURPOSE OF PROJECT. Construction of Cedar Canyon Dam was authorized by the Chief of Engineers on 3 June 1957, pursuant to provisions of Public Law 685, 84th Congress, 2nd Session, 11 July 1956. The authorization provided a plan to provide flood protection for the Red Dale Gulch Area of Rapid City, South Dakota.

1.3. LOCAL COOPERATION. The city of Rapid City, South Dakota, was the local sponsor for the project. As a condition for construction of the project, assurances from the city to the Secretary of the Army included the following:

The city would
(a) provide without cost to the United States all lands, easements, and rights-of-way necessary for the construction of the project.
(b) hold and save the United States free from damages due to construction works.
(c) maintain and operate the works after completion in accordance with regulations prescribed by the Secretary of the Army.
(d) construct an adequate storm sewer system in the development area, prior to construction of the project.

1.4. LOCATION AND DESCRIPTION OF PROJECT. Cedar Canyon Dam is located in Pennington County in southwestern South Dakota. It is on the northwest edge of Rapid City, South Dakota, and protects a residential section of the city (Red Dale Gulch Area) from the damaging effects of swift, short duration floods. The embankment of the dam crosses a normally dry gulch (Deadmans Gulch) which lies within Cedar Canyon. See Plate A1. The reservoir operates as a detention dam with the capacity to reduce peak discharges for floods of all magnitudes.

1.5. HISTORY OF CONSTRUCTION CONTRACTS. Cedar Canyon Dam was built by contract under the supervision of the Corps of Engineers, Department of the Army. Contract No. DA25-066-CIVENG-59-492, Cedar Canyon Dam, was advertised on 17 April 1959, and bids were opened 14 May 1959. Summit Construction Company of Rapid City, South Dakota, was awarded the contract with a bid of $68,469. Work on the project began on 12 June 1959 and was completed 30 September 1959. No unusual construction problems were encountered.

1.6. PROJECT MAINTENANCE. The city of Rapid City, South Dakota (the project sponsor), is responsible for all necessary maintenance required to assure proper performance of the project.

2. GEOLOGY. The foundation beneath the earth embankment in the valley consists of 4 to 10 feet of red clay overburden underlain by Minnekahta limestone bedrock. This overburden soil contains a rather large quantity of gravel boulders and hard gray limestone pockets. The clay overburden soils in the abutment areas are very shallow as evidenced by limestone outcrops from the valley floor to the crest.

3. SUBSURFACE EXPLORATION AND LABORATORY TESTING. The subsurface investigations at this dam consisted of three borings and one test trench in the spillway area and four test trenches in the upstream borrow area. The locations and identifying numbers of the borings and test trenches are shown on Plate A2, and a view of test trench No. 2 is shown on Plate B1.

Disturbed moisture and classification samples were taken at each boring and test trench at every change in material. Boring depths ranged from 3.4 feet to 10.8 feet depending on the depth of the underlying limestone bedrock, and test trenches were excavated to a depth of 10 feet. The overburden soils in the spillway and reservoir (borrow) areas were classified as lean, silty, and gravelly clays. Moisture contents ranged from 0.5 to 10.7 percent in the spillway area and 9.0 to 14.0 percent in the reservoir area. Liquid limits and plastic indexes ranged from 27 to 30 and 7 to 20, respectively, in the spillway area and 29 to 42 and 3 to 20, respectively, in the reservoir area. Logs of the borings are shown on Plate A3.

Compaction tests were performed on sack samples obtained from test trenches nos. 4 and 5. An optimum moisture content of 9.0 percent and a maximum dry density of 127 lbs/ft^3 was obtained.

4. FOUNDATION PREPARATION. Before work began, all vegetation, such as brush, heavy sod, heavy growth of grass, and all decayed vegetable matter, rubbish, and other unsuitable material within the area upon which fill was to be placed was removed. After completion of the clearing and stripping, all depressions were filled and steep slopes flattened. Following filling the depressions, and immediately prior to the placement of embankment fill, the foundation was loosened thoroughly by scarifying, plowing, or harrowing to a depth of 4 inches. After the removal of roots or other debris turned up in the loosening process, the foundation was compacted in preparation for placement of fill material.

5. EMBANKMENT.

5.1. GENERAL. A discussion of the design and construction of the embankment is presented below. It includes a description of the embankment section, embankment materials, and procedures followed in constructing the embankment.

5.2. EMBANKMENT SECTION. The embankment is a rolled, homogeneous, impervious earthfill. It has a crest length of 1,320 feet and a crest width of 15 feet. It is 42 feet high and has a crest elevation of 3554.0 feet m.s.l. The embankment slopes are symmetrical (1V on 3H) and both faces are protected by rock slope protection. Details of the embankment are shown on Plates A4, A5, and A6. Views of the embankment features are shown on Plates B1 through B4.

5.3. EMBANKMENT DESIGN. The design of the embankment and structures was based upon the following criteria:

(1) Flood storage capacity sufficient to retain the volume of a Standard Project Flood from the contributing drainage area less releases from an uncontrolled outlet.

(2) Outlet capacity sufficient to discharge a Standard Project Flood within 5 days.

(3) Spillway capacity ample to pass the Maximum Probable Flood occuring 5 days after inflow from the Standard Project Flood. (NOTE: Since the SPF is discharged in 5 days by the conduit, the reservoir level will be at the conduit invert when the MPF occurs.)

(4) Embankment freeboard of 4 feet above the maximum pool elevation.

(5) Capacity for a sediment volume of 20 acre-feet, equivalent to about 1.0 acre-feet per square mile per year during the life of the project.

Based on this criteria, the dam was expected to reduce annual flood damages below the project by 80 percent.

5.4. SEEPAGE. Since Cedar Canyon Dam was not designed for permanent storage of water, seepage through the embankment and foundation was expected to be negligible, and therefore, underseepage control structures were not provided.

5.5. EMBANKMENT MATERIALS.

5.5.1. Earthfill. The embankment was constructed from the lean clay material located within the reservoir area. The material provided a relatively impervious embankment section consisting of 139,200 cubic yards of homogeneous rolled earth fill.

5.5.2. Slope Protection. Both faces of the dam are protected by rock slope protection to elevation 3554.0 (Crest of Dam). The rock used was excavated Minnekahta limestone from the spillway and reservoir (borrow) areas. The minimum thickness of the slope protection was 1.5 feet upstream

and 0.75 feet downstream, with the maximum rock size allowed being 0.5 foot greater than the layer thickness. Details of the slope protection are given on Plates A5 and A6, and views of the rock slope protection are shown on Plates B2, 3, 4, and 5.

5.6. EMBANKMENT PLACEMENT.

5.6.1. General. Specifications required that the gradation and distribution of materials throughout the earthfill section of the dam be such that the embankment be free from lenses, pockets, streaks, and layers of material differing substantially in texture or gradation from surrounding material. See Plate B6 for views of the embankment during construction.

5.6.2. Compacted Embankment Fill. The more impervious of the compacted fill materials were placed toward the upstream section of the embankment, and the more pervious of the fill materials were placed toward the downstream section of the embankment; this was to provide a transition in permeability from the upstream to the downstream portions of the embankment.

After dumping, the material was spread in approximate horizontal layers over fill areas. The thickness of the layers before compaction was specified as follows:

Material	Maximum Thickness of Lift	Type of Roller
Compacted Fill	12-inch Loose Measurement	Rubber-tired*
Compacted Fill	8-inch Loose Measurement	Tamper-type

*Available information indicates that only tamper-type rollers were used for embankment compaction.

The moisture content of the layers was required to be uniform throughout the layer. The upper limit of moisture content was that which permitted excavating, hauling, placing, and compaction of the fill materials without excessive deformation of the embankment. The lower limit was one percent below the optimum moisture content. The surface of the fill was crowned with a 5 percent grade to insure good drainage during the construction period. Before compaction, each layer of fill was harrowed, if required, to break up and blend materials and to obtain uniform moisture contents. When the moisture content and the condition of the layer was satisfactory, it was compacted by six complete passes of a tamping roller. If, in the opinion of the Contracting Officer, the required density of any area was considered insufficient, additional passes were made until the desired compaction was obtained. Portions of the fill which could not be compacted with rollers because of space restrictions were placed in 4-inch loose lift layers and compacted with power tampers to the same degree of compaction as that obtained on other portions of the fill performed by rolling.

5.6.3. Slope Protection Placement. Rock slope protection was placed in such a manner as to produce a reasonably well-graded mass of rock with a minimum percentage of voids, and was constructed to the layer thickness, lines and grades as shown on the drawings. A tolerance of 6 inches above the layer thickness was allowed for the maximum size stone, but in order to permit the use of available rock, an occasional rock was allowed to protrude above the 6 inch tolerance on that portion of the embankment where larger stones were used.

6. EMERGENCY SPILLWAY. The emergency spillway is an uncontrolled channel located in the right abutment of the dam. See Plate A4. It has a crest elevation of 3545.0 feet m.s.l., is 60 feet wide and 650 feet long. The channel has vertical side slopes from the crest elevation to elevation 3556.4 feet m.s.l., has 20-foot berms, then 1V on 2H side slopes to the top of the existing ground. The vertical side slopes and berms were excavated in the Minnekahta limestone bedrock and the 1V on 2H slopes were excavated in the lean clay overburden. The overburden soils on the 1V on 2H slopes were loosened, pulverized, and seeded with crested wheat and smooth brome for protection against wind and water erosion. The spillway is capable of passing the Maximum Probable Flood occuring 5 days after inflow from the Standard Project Flood. Sections and details of the spillway are shown on Plates A5 and A6, and views of the spillway are shown on Plates B7, B8, and B9.

7. OUTLET WORKS. The outlet works consist of an uncontrolled conduit, a concrete headwall structure and metal pipe trashrack located at the inlet, and a concrete support pedestal at the outlet. The conduit is a 230-foot long, 24-inch diameter, bituminous coated corrugated metal pipe. It has an inlet invert elevation of 3526.0 feet m.s.l. and a 4.3 percent slope to the outlet invert elevation of 3516.0. Four seepage diaphragms were constructed along the conduit to prevent piping due to seepage through the embankment along the conduit. An outfall channel was excavated below the outlet of the conduit and terminates in a rock walled canyon approximately 150 feet beyond the outlet. Location, sections, and details of the outlet works are shown on Plates A4, A6, and A7, and views of the structure are shown on Plates B10 and B11.

8. INSTRUMENTATION. Cedar Canyon Dam has no instrumentation. A staff gauge for the reservoir was recommended in Periodic Inspection Reports Nos. 2 and 3, but has not as yet been installed.

9. OPERATIONAL HISTORY.

9.1. GENERAL. The city of Rapid City, South Dakota, the project sponsor, is responsible for the operation and maintenance of the embankment, spillway, and other structures which comprise the project.

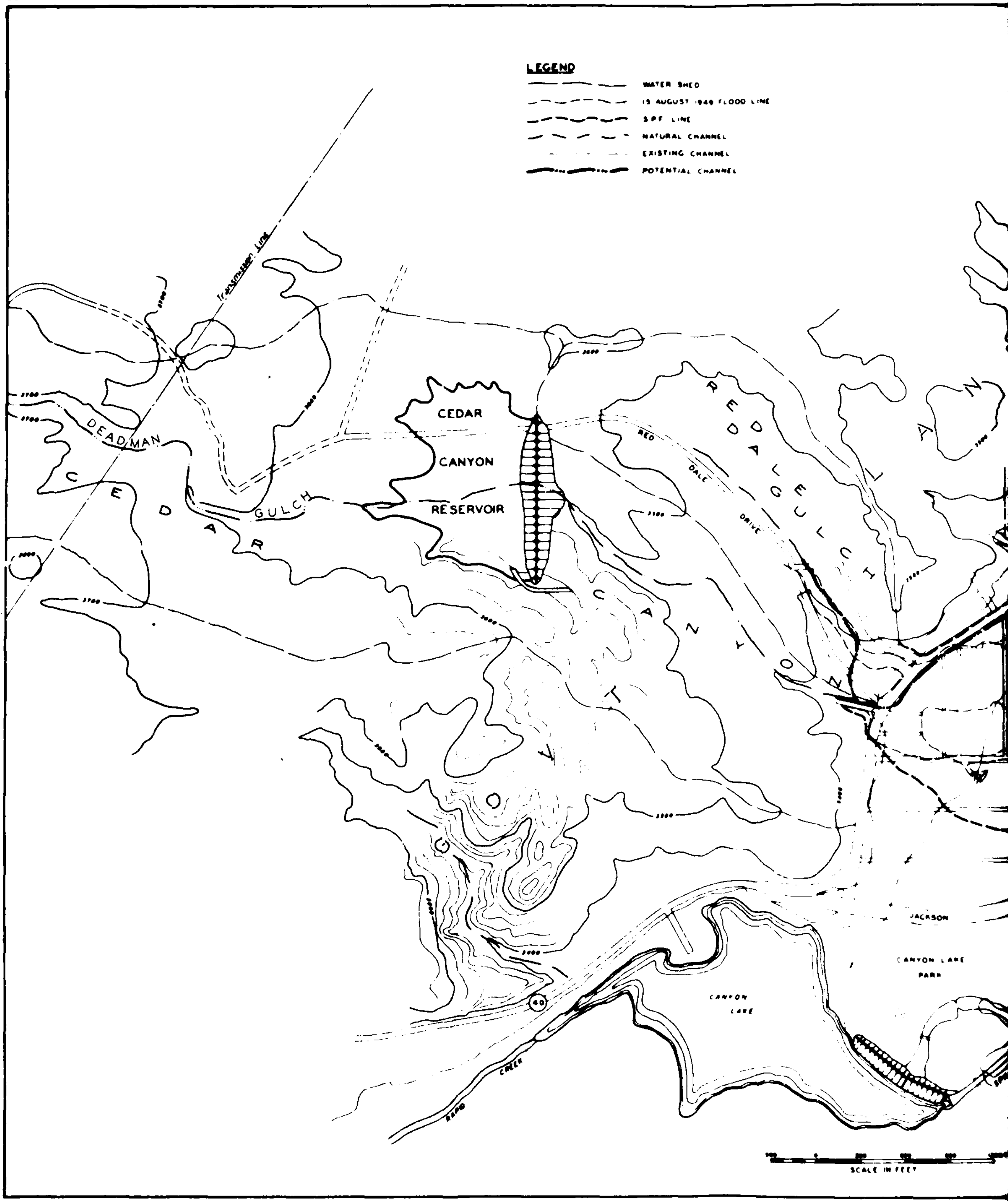
9.2. INSPECTIONS. In-depth inspections of Cedar Canyon Dam are conducted in accordance with ER 1100-2-100, "Periodic Inspections and Continuing Evaluation of Completed Civil Works Projects." These inspections are reported in Periodic Inspection Report Nos. 1, 2, and 3, dated May 1970, September 1975, and September 1980 respectively. The next periodic inspection of Cedar Canyon Dam is scheduled for 1985. The inspections are made jointly by representatives of the Operations and Engineering Divisions of the Omaha District Corps of Engineers and by representatives of the Missouri River Division Office. The reports include the evaluation of the embankment and structural performance, plus recommendations for necessary repairs.

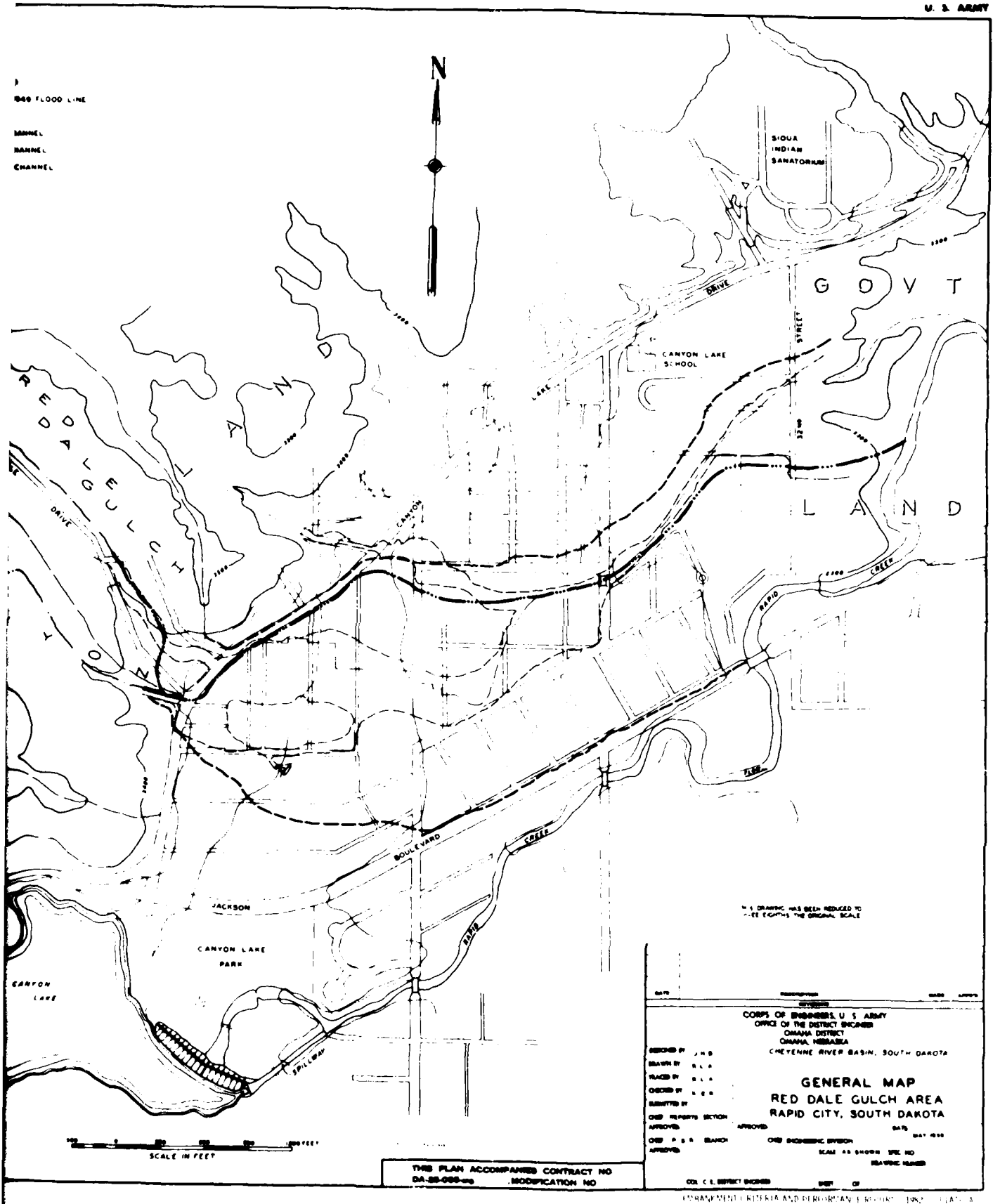
In addition to the periodic inspections, semi-annual reports to the District Engineer covering inspection, maintenance, and operation of the project are required. The reports are made by the "superintendent" of the project, who is appointed by the local sponsor.

9.3. RESERVOIR LEVELS. There has been little water impoundment in the reservoir since the construction of the dam, and it is believed that water has never discharged through the conduit. Since there are no gauges at the dam, the monitoring of reservoir stage and conduit flow is dependent upon onsite inpsections.

10. PERFORMANCE. Cedar Canyon Dam and appurtenant structures are in good condition. Since 1959, when the project was completed, inspections have revealed no significant problems concerning the safety of the dam. The dam though, is normally dry and has never been tested by a serious flood event. It was recommended in the periodic inspection reports (1975, 1980) that the project be inspected whenever the pool reaches the invert of the outlet conduit so that it can be checked for seepage and performance at high pool levels.

APPENDIX A
DRAWINGS


LEGEND
WATER SHED
15 AUGUST 1949 FLOOD LINE
S.P.F. LINE
NATURAL CHANNEL
EXISTING CHANNEL
POTENTIAL CHANNEL
Transmission Line
DEADMAN
GULCH
CEDAR
CEDAR
CANYON
RESERVOIR
REDDALE GULCH
RED DALE DRIVE
CANYON
JACKSON
CANYON LAKE PARK
CANYON LAKE
RAPID CREEK
40
SCALE IN FEET



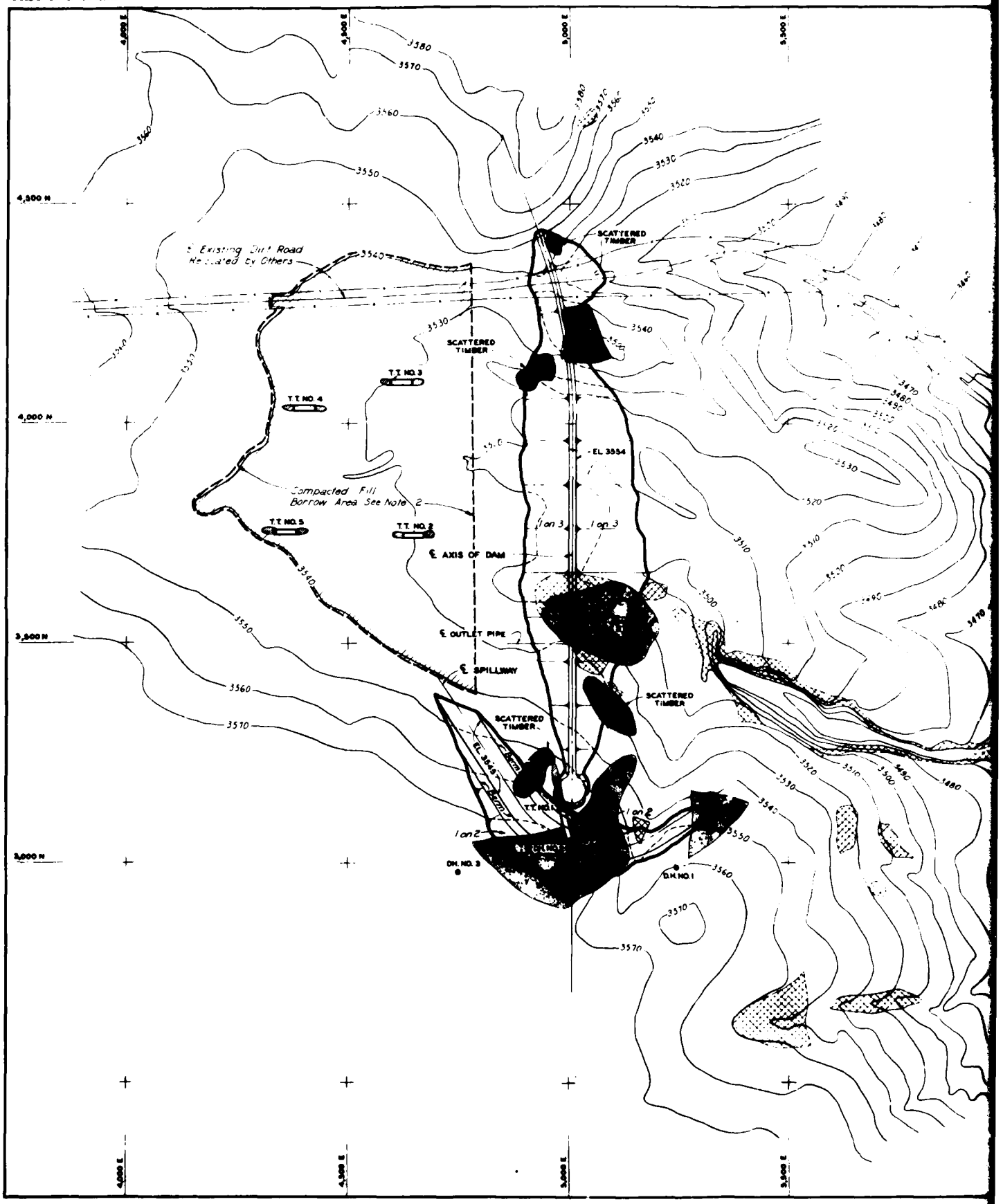
THIS PLAN ACCOMPANIES CONTRACT NO DA-23-066-eng-[illegible] MODIFICATION NO

CORPS OF ENGINEERS, U. S. ARMY
OFFICE OF THE DISTRICT ENGINEER
OMAHA DISTRICT
OMAHA, NEBRASKA
CHEYENNE RIVER BASIN, SOUTH DAKOTA

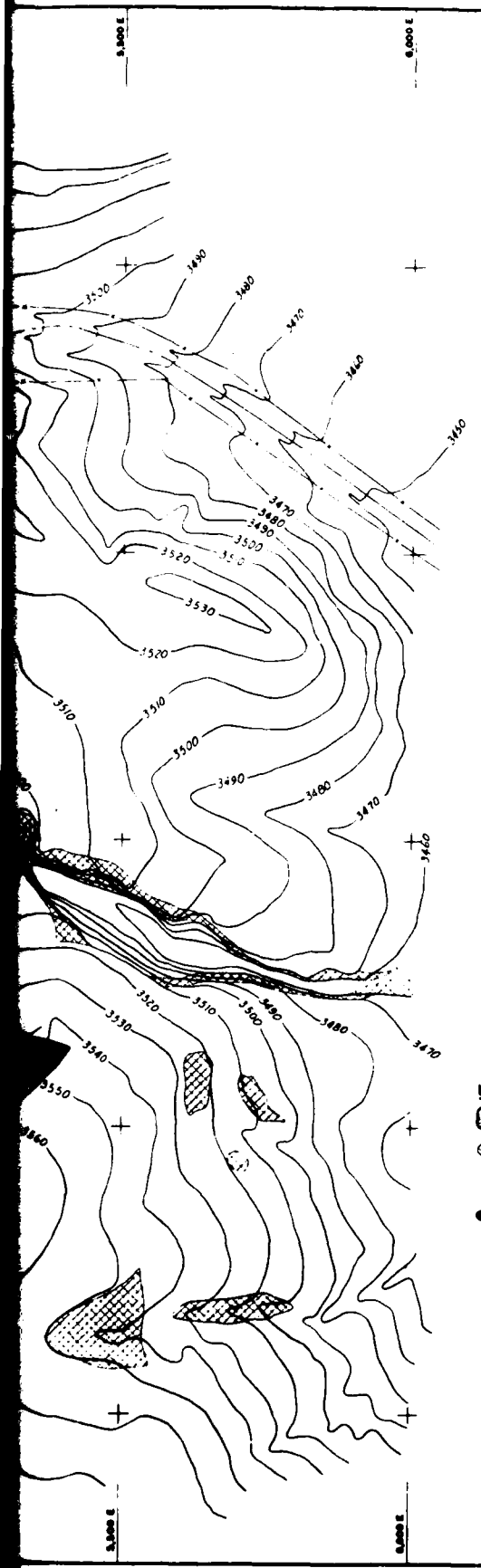
GENERAL MAP
RED DALE GULCH AREA
RAPID CITY, SOUTH DAKOTA

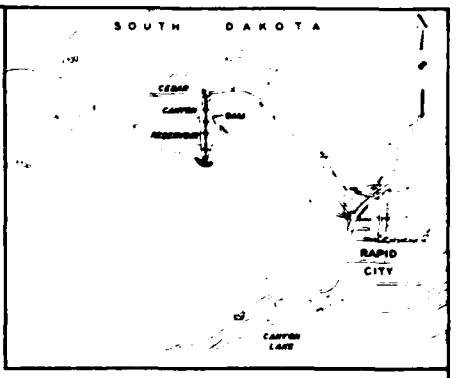
SCALE AS SHOWN

CORPS OF ENGINEERS



U. S. ARMY





VICINITY MAP

SCALE IN FEET

GENERAL NOTES:

1. All elevations shown refer to feet above M.S.L., U.S.C.&G.S. 1929 General Adjustment.
2. Compacted fill borrow area limits are approximate and may be increased as directed. Maximum depth of excavation for compacted fill material shall be ten (10) feet.

LEGEND:

- TIMBER AREA REMOVED THIS CONTRACT
- LIMESTONE OUTCROPS
- DRILL HOLE
- TEST TRENCH AND SPOIL

SCALE: 1 INCH = 100 FEET

SAFETY PAYS

THIS PLAN ACCOMPANIES CONTRACT NO. DA-56-006-CIV ENGR-59-462

1-59	Revised to show "As-Built" conditions		
8-4-59	Revised gallery excavation		

U.S. ARMY ENGINEER DISTRICT, OMAHA
CORPS OF ENGINEERS
OMAHA, NEBRASKA

CHEYENNE RIVER BASIN, SOUTH DAKOTA

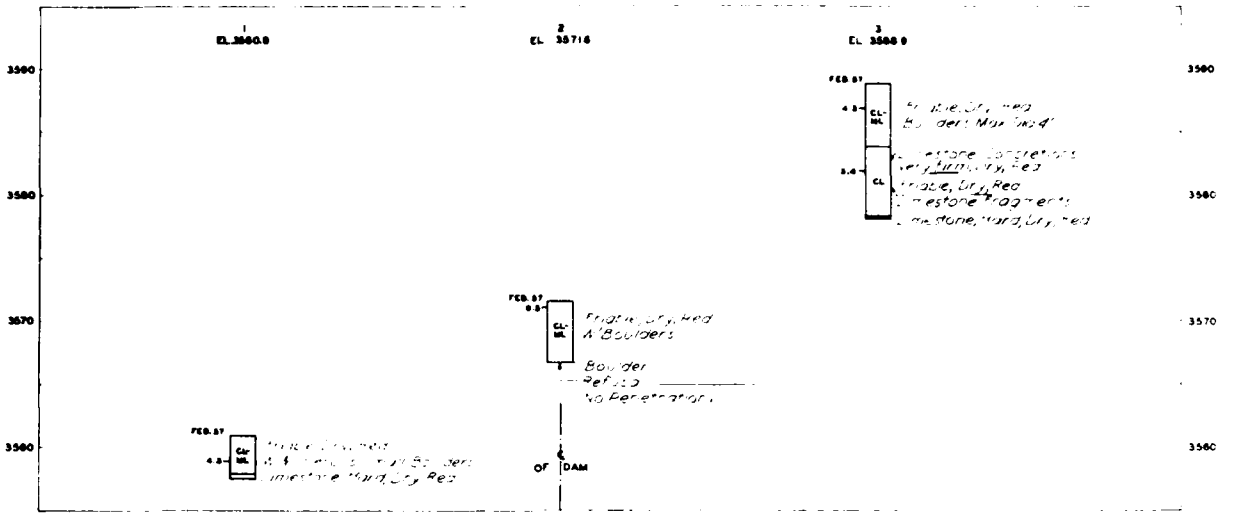
RED DALE GULCH AREA
RAPID CITY, SOUTH DAKOTA
CEDAR CANYON DAM
GENERAL PLAN

APPROVED: [signature] DIVISION ENGINEER

DATE: APRIL 1960

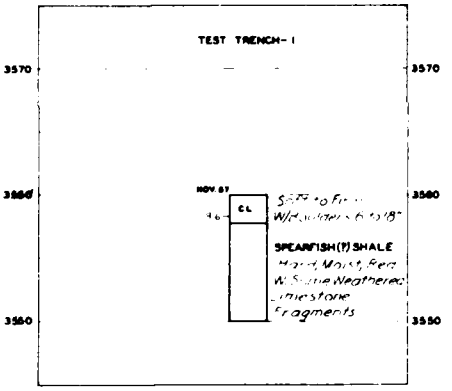
APPROVED: [signature] DISTRICT ENGINEER

DRAWING NUMBER: CV25e1-40E1.2

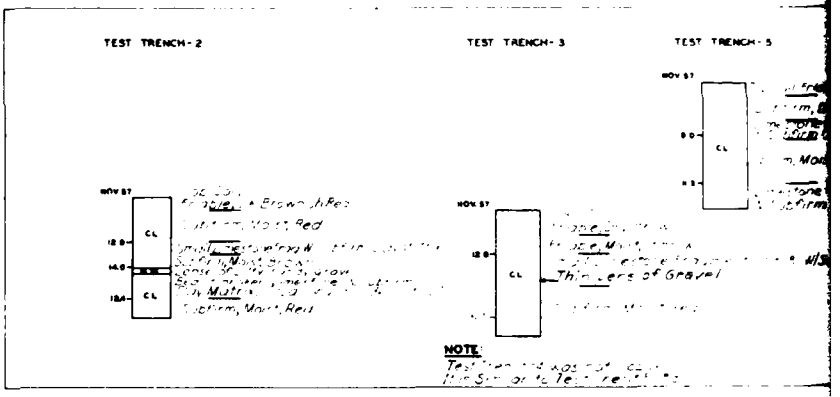


BORINGS IN SPILLWAY AREA

NO HORIZONTAL SCALE



TEST TRENCH IN THE SPILLWAY AREA



TEST TRENCHES IN THE RESERVOIR AREA

NO HORIZONTAL SCALE

NOTES

3580

3580

3570

3580

TEST TRENCH - 3

TEST TRENCH - 5

NOV 57

3540

3530

3520

CL

Thin Lens of Gravel

NOTE:

CHES IN THE RESERVOIR AREA

NO HORIZONTAL SCALE

LEGEND

NOV 57

12.0

11.0

CL

GM

CLASSIFICATION OF SOILS

GM

GC-SC

CL

DESCRIPTIVE NOTES

OVERBURDEN –

SPEARFISH FORMATION –

MINNEKAHTA FORMATION –

GENERAL NOTES

REFERENCE DRAWINGS:

General Plan and Index

DWG. NO.

11-19-58 Revised to show "As-Built" conditions

NOTES

THIS PLAN ACCOMPANIES CONTRACT NO. DA-25-066-eng- , MODIFICATION NO.

U.S. ARMY ENGINEER DISTRICT, OMAHA
CORPS OF ENGINEERS
OMAHA, NEBRASKA

CHEYENNE RIVER BASIN, SOUTH DAKOTA

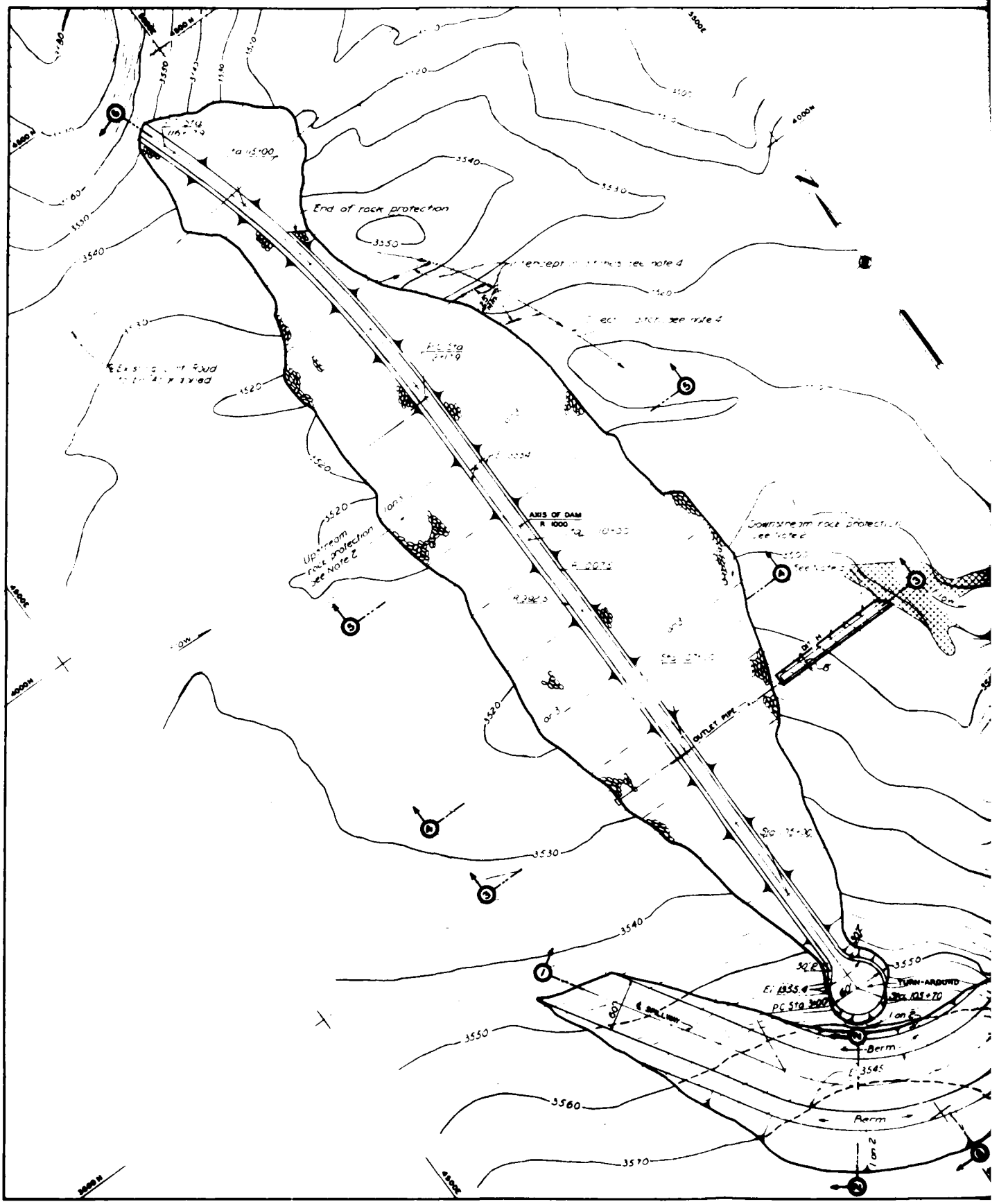
RED DALE GULCH AREA
RAPID CITY, SOUTH DAKOTA

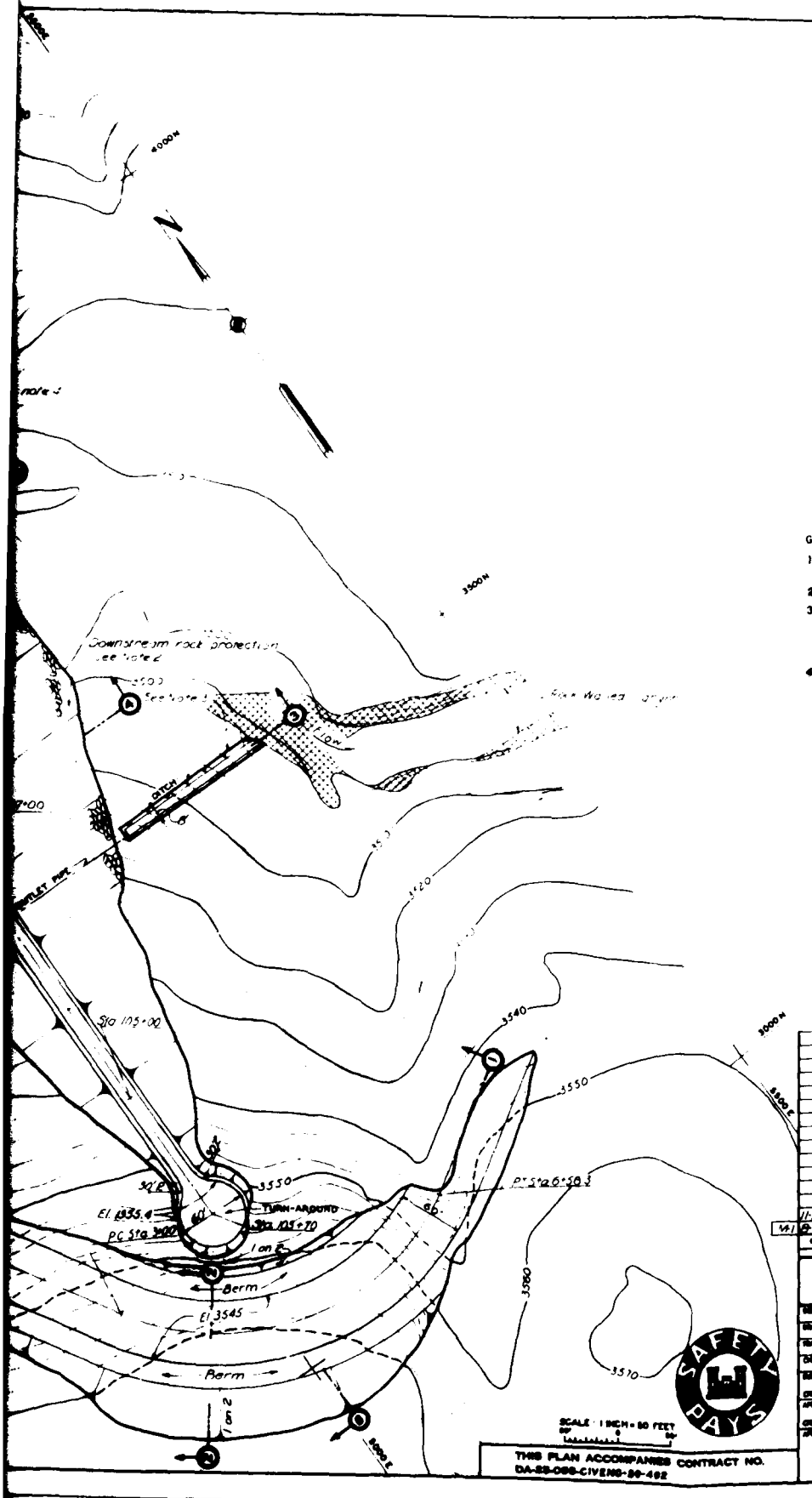
CEDAR CANYON DAM

RECORD OF BORINGS AND TEST TRENCHES

DESIGNED BY A.E.R.
DRAWN BY C.W.D.
TRACED BY C.W.D.
CHECKED BY A.E.R.
CHIEF GEOLOGY SECTION
APPROVED
CHIEF FDN. & BITL'S BRANCH
APPROVED
CHIEF ENGINEERING DIVISION
DATE APRIL, 57
APPROVED
O.H. Hammond
COL., C. E., DISTRICT ENGINEER
SCALE AS SHOWN
DRAWING NUMBER CY25c1-40 E 7.1
SHEET OF

SAFETY PAYS


End of rock protection
AXIS OF DAM
R 1000
Upstream rock protection see Note 2
Downstream rock protection see Note 2
OUTLET PIPE
TURN-AROUND
Berm
Berm
3540
3550
3560
3570
3530
3520



GENERAL NOTES:

1. All elevations shown refer to feet above M.S.L., U.S.C.&G.S. 1929 General Adjustment.
2. For rock protection see [illegible]
3. Excavate an 8' minimum width ditch 3' in depth or to bottom of overburden, whichever is higher, graded to drain. Minor adjustments in alignment may be made by the Contracting Officer to accomodate for field conditions.
4. Interceptor and Collector ditches to be excavated in a manner to prevent excessive erosion of the embankment toe. Additional ditches will be excavated at locations as directed by the Contracting Officer. See "Typical Section" [illegible]

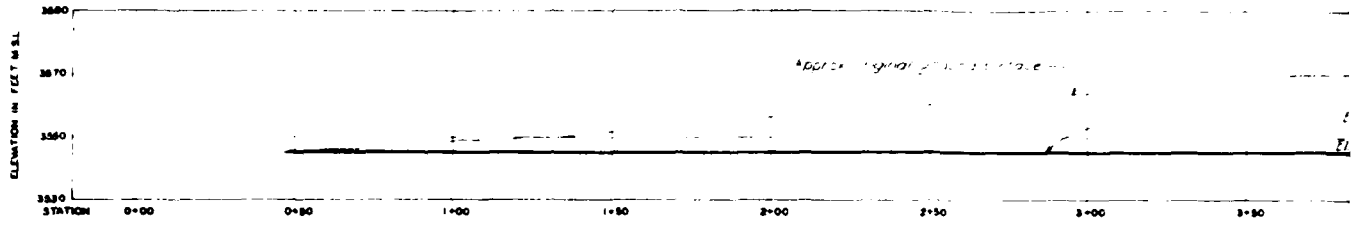
11-19-59	Revised to show As Built [illegible]	[illegible]	[illegible]
1-11-60	Revised rock protection & spillway [illegible]	[illegible]	[illegible]

U.S. ARMY ENGINEER DISTRICT, OMAHA
CORPS OF ENGINEERS
OMAHA, NEBRASKA

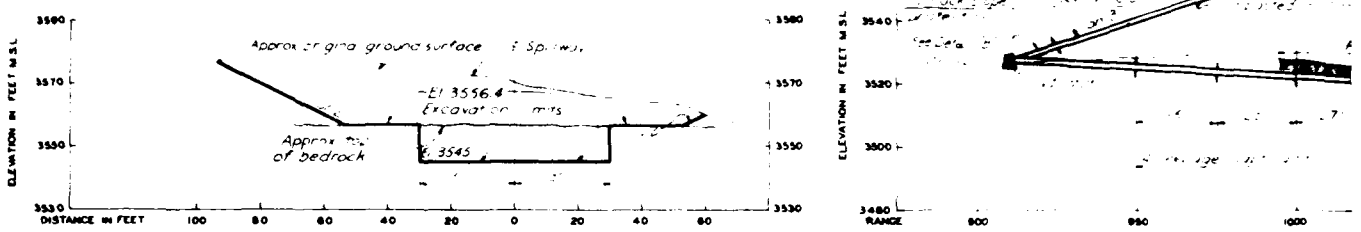
DESIGNED BY: J.B.W.
DRAWN BY: C.W.D.
TRACED BY: C.W.D.
CHECKED BY: L.J.S.
QUANTITIES BY: P.K.L.
CHIEF, ENGR. DIV.: [illegible]
CHIEF, CONSTR. DIV.: [illegible]
APPROVED: [illegible]
CHIEF, ENGINEERING DIVISION
DATE: APRIL 1959
APPROVED: B.E. Hammond
COL., C.E., DISTRICT ENGINEER
SCALE, AS SHOWN
DRG. NO.
CY25c1-40E3.2
SHEET OF

CHEYENNE RIVER BASIN, SOUTH DAKOTA
RED DALE GULCH AREA
RAPID CITY, SOUTH DAKOTA
CEDAR CANYON DAM
EXCAVATION AND EMBANKMENT PLAN

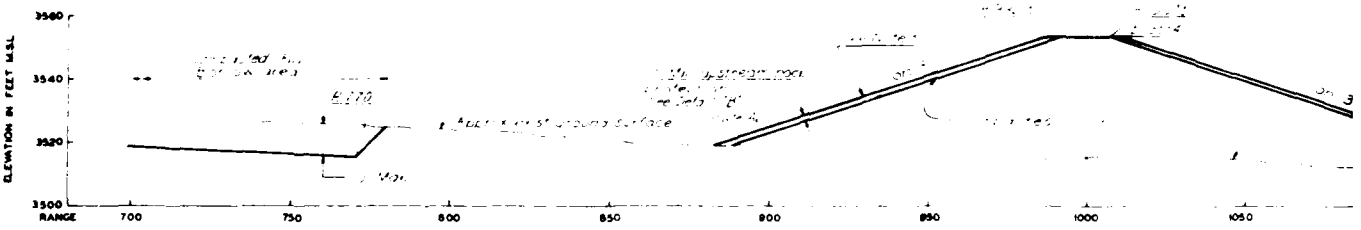
THIS PLAN ACCOMPANIES CONTRACT NO. DA-23-066-CIVENG-59-402



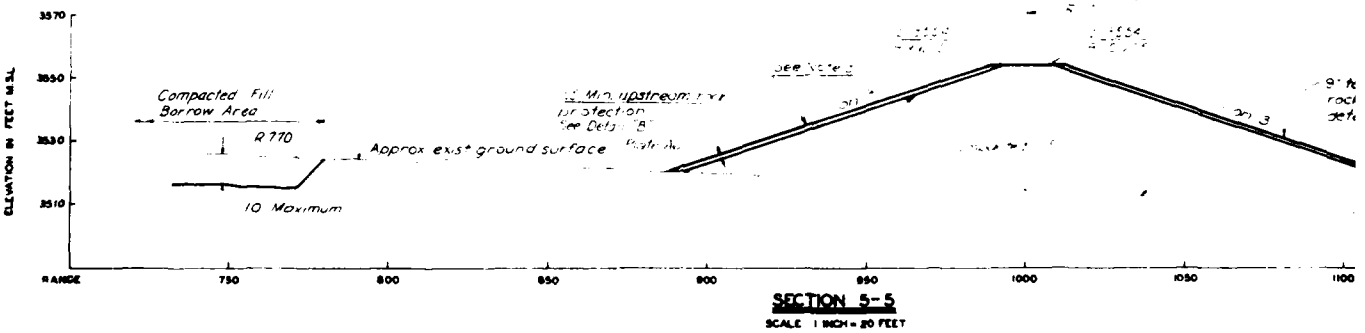
SPILLWAY PROFILE 1-1
SCALE 1 INCH = 20 FEET



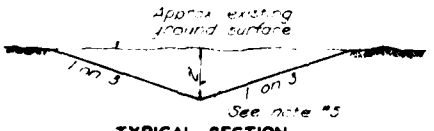
SECTION 2-2
SCALE 1 INCH = 20 FEET



SECTION 4-4
SCALE 1 INCH = 20 FEET

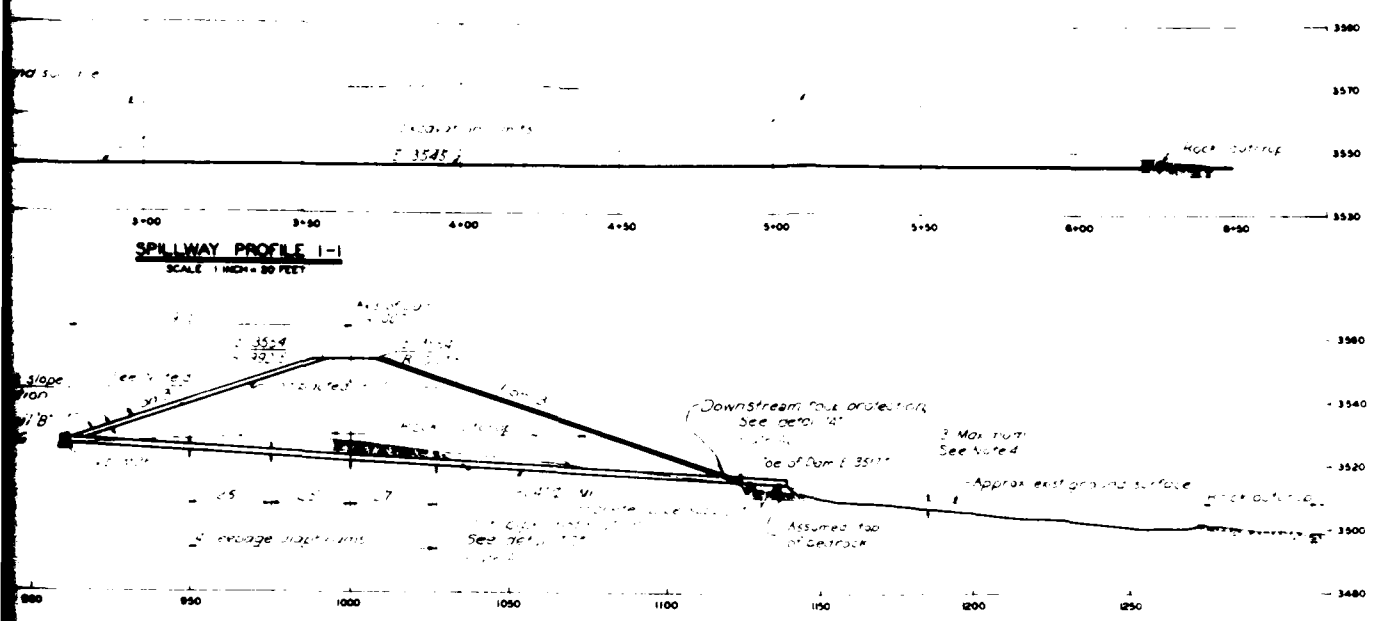


SECTION 5-5
SCALE 1 INCH = 20 FEET



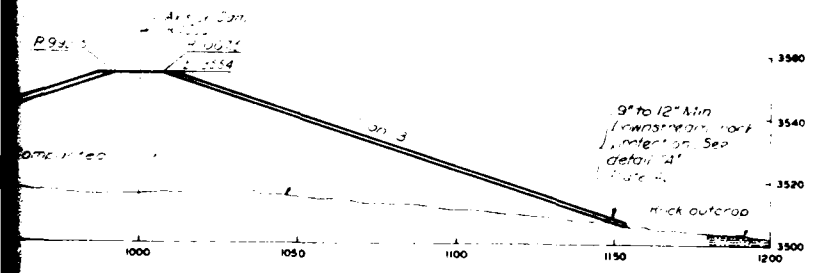
TYPICAL SECTION
COLLECTOR & INTERCEPTOR DITCHES
NO SCALE

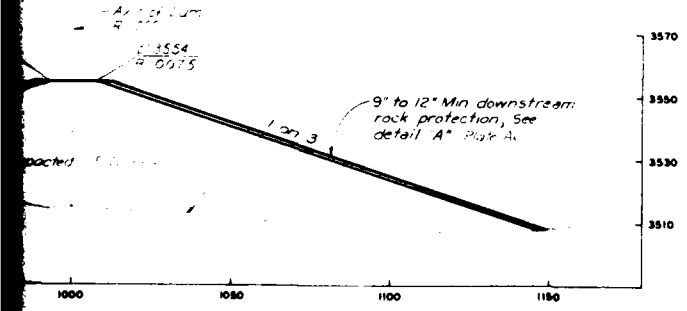
U. S. ARMY



SPILLWAY PROFILE I-I
SCALE 1 INCH = 20 FEET

SECTION 3-3
SCALE 1 INCH = 20 FEET





GENERAL NOTES:

1. All elevations shown refer to feet above M.S.L., U.S.C.& G.S. 1929 General Adjustment.
2. Due to a limited subsurface investigation of the construction area, no attempt has been made to show the approximate top of bedrock on the sections. The location of the field investigations are shown on . and the field information obtained is shown on .
3. Place upstream and downstream rock protection to El.3554.
4. Ditch to be excavated 3 feet in depth or to the top of bedrock, whichever occurs at the higher elevation.
5. Ditch depth may be reduced in area where existing overburden is less than 2' thick.

11-19-58 Revised to show "As Built" conditions
MI 8459 Rev. sht ... Dam & Spillway ...

U.S. ARMY ENGINEER DISTRICT, OMAHA
CORPS OF ENGINEERS
OMAHA, NEBRASKA

CHEYENNE RIVER BASIN, SOUTH DAKOTA
RED DALE GULCH AREA
RAPID CITY, SOUTH DAKOTA
CEDAR CANYON DAM
EXCAVATION AND EMBANKMENT SECTIONS

DESIGNED BY J.P.B.
DRAWN BY C.W.D.
TRACED BY C.W.D.
CHECKED BY L.J.S.
SUBMITTED BY
APPROVED
APPROVED
APPROVED
DATE APRIL 1959
SCALE: AS SHOWN
DRAWING NUMBER CY25c1-40E4.2
SHEET OF

B.J. Hammond
COL., C. E., DISTRICT ENGINEER

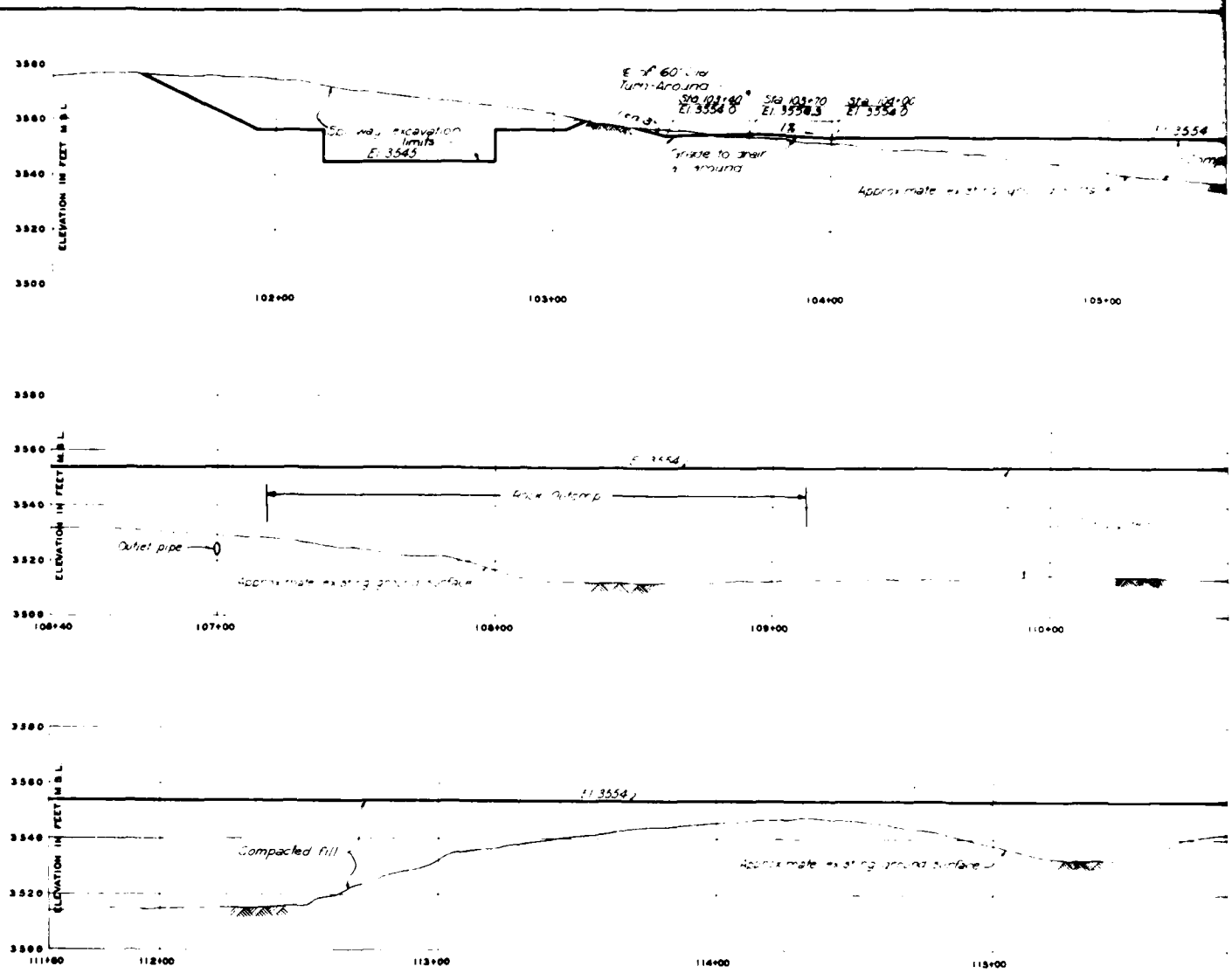
SCALE 1 INCH = 20 FEET

THIS PLAN ACCOMPANIES CONTRACT NO.
DA-25-066-CIVENG-59-492

SAFETY PAYS

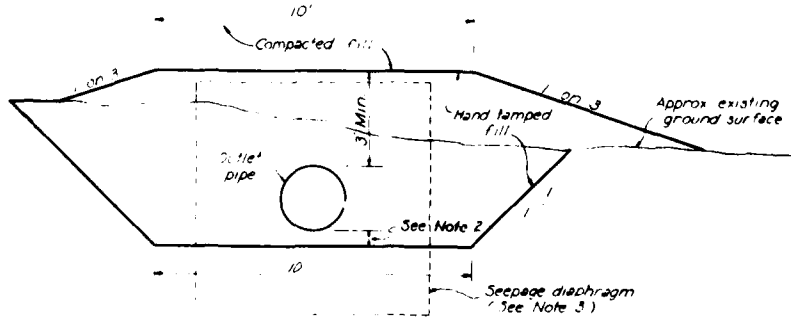
EMBANKMENT CRITERIA AND PERFORMANCE REPORT 1962

CORPS OF ENGINEERS



PROFILE 6-6

SCALE 1 INCH = 20 FEET



DETAIL "C"

EXCAVATION AND BACKFILL DETAIL

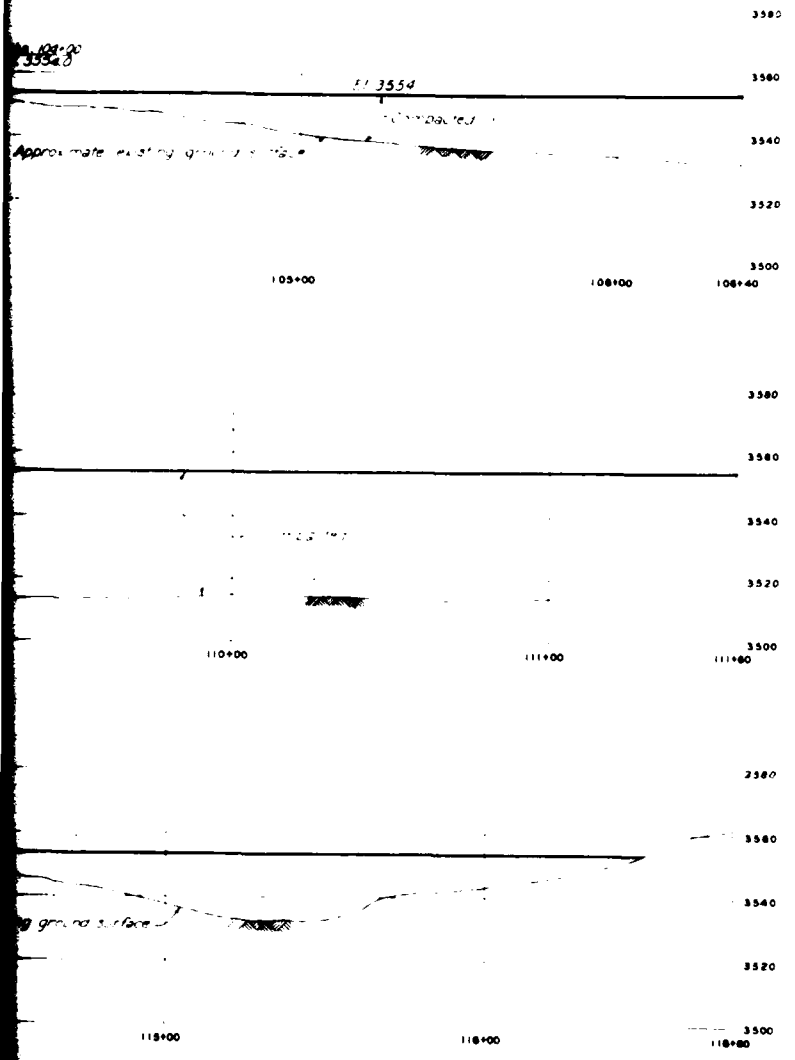
OUTLET PIPE INSTALLATION

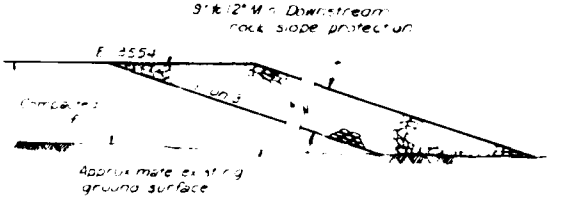
NO SCALE

DETAIL "B"

UPSTREAM ROCK PROTE

NO SCALE





DETAIL "A"
DOWNSTREAM ROCK PROTECTION
NO SCALE

GENERAL NOTES:

1. All elevations shown refer to feet above M.S.L., U.S.C.&G.S. 1929 General Adjustment.
2. Dimension shown shall be 6" minimum compacted fill for pipe bedding where excavation is in rock. If excavation to invert of pipe is in overburden, the dimension shown shall be zero.
3. Excavate both sides of seepage diaphragms to permit room for hand-tamping backfill, minimum clearance two (2) feet.
4. Due to limited subsurface investigation of the construction area, no attempt has been made to show the approximate top of bedrock on the sections. Limits of rock outcrops are shown.

DETAIL "B"
UPSTREAM ROCK PROTECTION
NO SCALE

DATE	DESCRIPTION	MADE	APPR'D
11-19-59	Revised to show "As Built" conditions		
6-14-57	Revised rock protection & spillway excavation		

U.S. ARMY ENGINEER DISTRICT, OMAHA
CORPS OF ENGINEERS
OMAHA, NEBRASKA

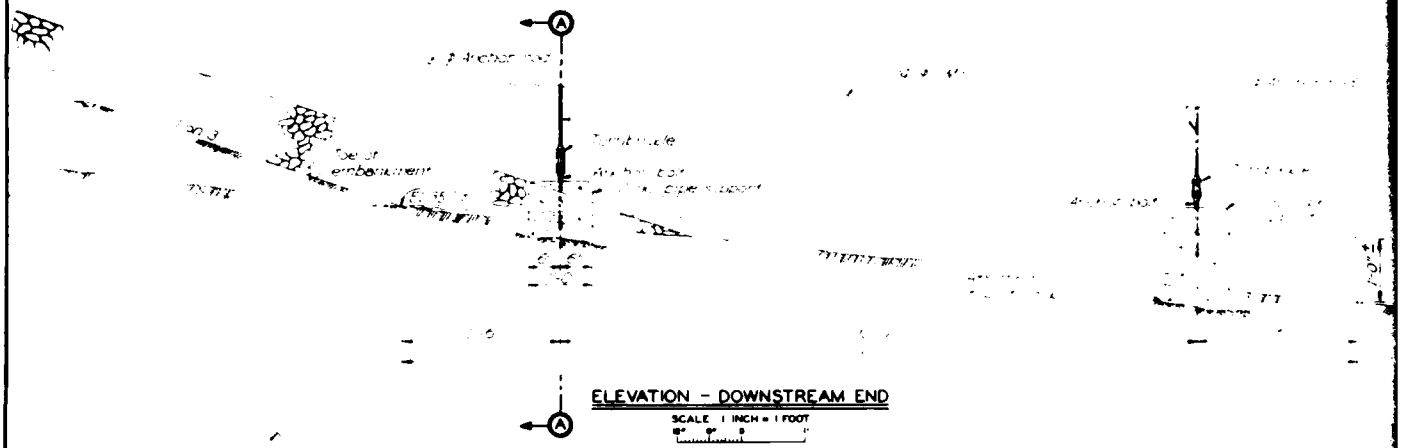
CHEYENNE RIVER BASIN, SOUTH DAKOTA
RED DALE GULCH AREA
RAPID CITY, SOUTH DAKOTA
CEDAR CANYON DAM
EMBANKMENT PROFILE AND DETAILS

APRIL 1958

CY25c1-40E5.2

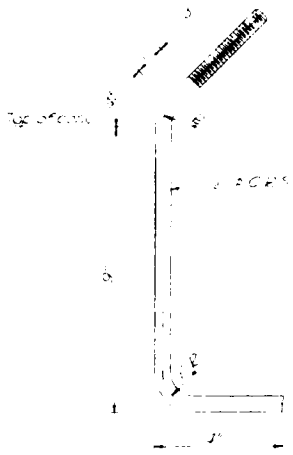
SAFETY PAYS

THIS PLAN ACCOMPANIES CONTRACT NO.
DA-25-066-CIVENG-58-498



ELEVATION - DOWNSTREAM END

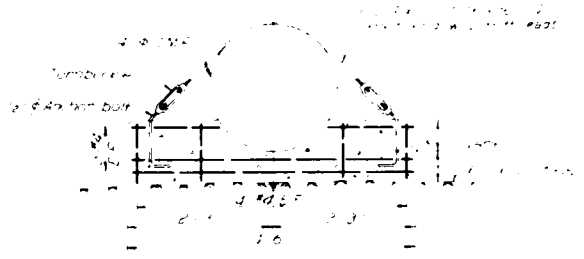
SCALE 1 INCH = 1 FOOT



ANCHOR BOLT DETAIL

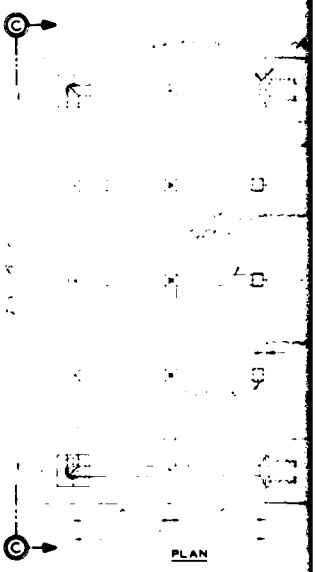
FOUR REQUIRED

SCALE 6 INCHES = 1 FOOT

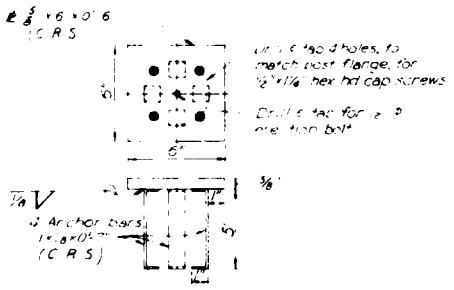


SECTION A-A

SCALE 1 INCH = 1 FOOT



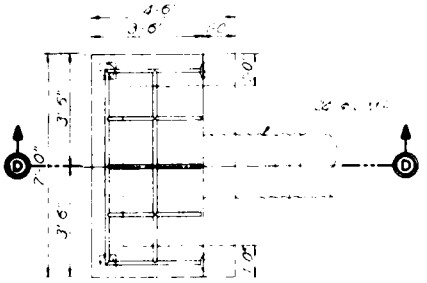
PLAN



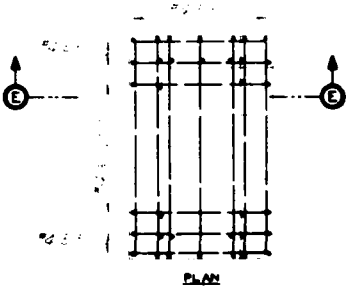
ANCHOR PLATE DETAILS

FOUR REQUIRED

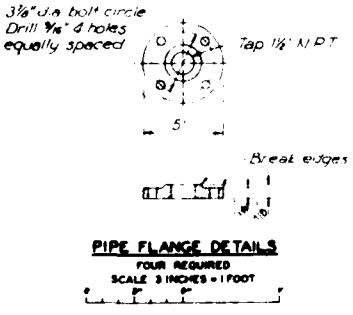
SCALE 3 INCHES = 1 FOOT



PLAN



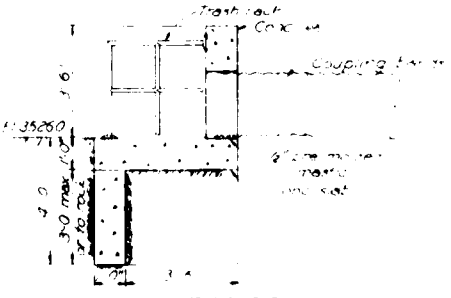
PLAN



PIPE FLANGE DETAILS

FOUR REQUIRED

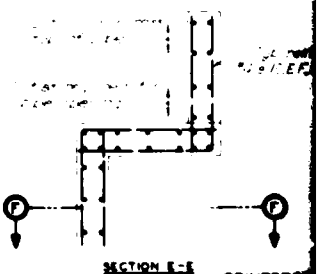
SCALE 3 INCHES = 1 FOOT



SECTION D-D

CONCRETE DETAILS

SCALE 1 INCH = 1 FOOT



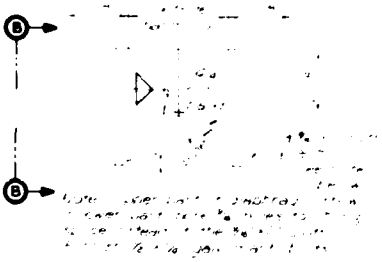
SECTION E-E

REINFORC

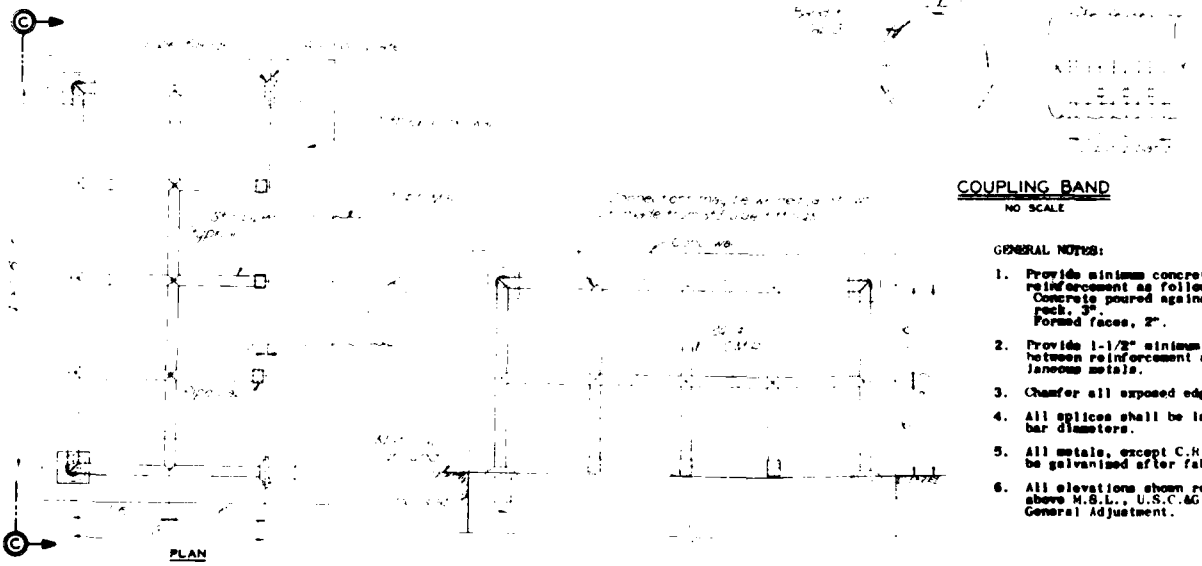
SCALE

INLET STRUCTURE

ELEVATION B-B
NO SCALE



SEEPAGE DIAPHRAGM
NO SCALE



PLAN

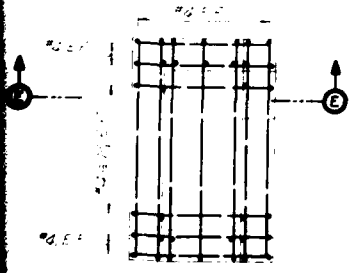
VIEW C-C

COUPLING BAND
NO SCALE

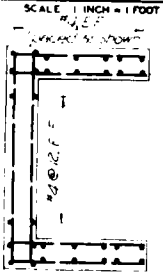
GENERAL NOTES:

1. Provide minimum concrete cover for reinforcement as follows:
   Concrete poured against earth or rock, 3".
   Formed faces, 2".
2. Provide 1-1/2" minimum clearance between reinforcement and miscellaneous metals.
3. Chamfer all exposed edges 3/4".
4. All splices shall be lapped 30 bar diameters.
5. All metals, except C.R.S., shall be galvanized after fabrication.
6. All elevations shown refer to feet above M.S.L., U.S.C.&G.S. 1929 General Adjustment.

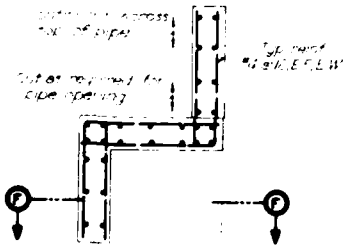
TRASH RACK DETAILS
SCALE 1 INCH = 1 FOOT



PLAN

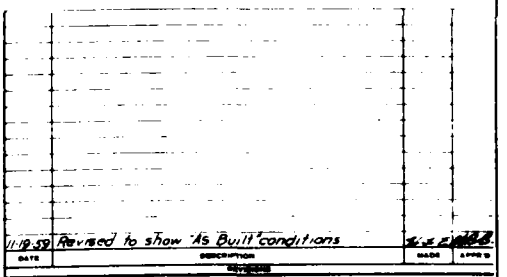


SECTION F-F



SECTION E-E

REINFORCING DETAILS
SCALE 1 INCH = 1 FOOT



DATE	DESCRIPTION	MADE	APPR'D
11-19-59	Revised to show "As Built" conditions		

U.S. ARMY ENGINEER DISTRICT, OMAHA
CORPS OF ENGINEERS
OMAHA, NEBRASKA

DESIGNED BY: R W H
DRAWN BY: A & D
TRACED BY: A & D
CHECKED BY: H E H

CHEYENNE RIVER BASIN, SOUTH DAKOTA
RED DALE GULCH AREA
RAPID CITY, SOUTH DAKOTA
CEDAR CANYON DAM
OUTLET PIPE CONSTRUCTION DETAILS

SUBMITTED: C. H. Chapman, CHIEF, DESIGN BRANCH
APPROVED: [signature], CHIEF, ENGINEERING DIVISION
APPROVED: O. J. Hammond, COL., C. E., DISTRICT ENGINEER
DATE: APRIL 1960
SCALE: AS SHOWN
SPEC. NO.
CY25c1-40E81

SAFETY DAYS

THIS PLAN ACCOMPANIES CONTRACT NO. DA-25-066-eng- , MODIFICATION NO.

APPENDIX B
PHOTOGRAPHS

PHOTO NO. 1 - View of test trench No. 2 - shows borrow material used for compacted fill.

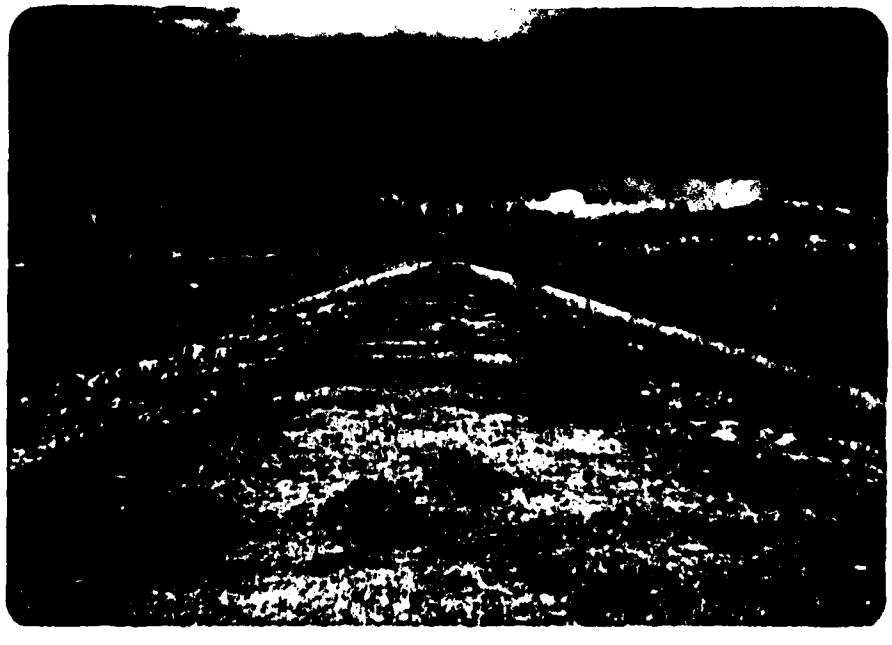


PHOTO NO. 2 - View of the crest of the embankment looking towards the left abutment.

PHOTO NO. 3 - Panoramic view of the upstream slope of the embankment. SEP

PLATE B2

PHOTO NO. 4 - View of upstream slope of the embankment looking towards the left abutment.

PHOTO NO. 5 - View of upstream embankment slope looking towards the right abutment.

PHOTO 6 - Panoramic view of the downstream slope of the embankment as photographed from the [illegible] SEP pile adjacent to the left abutment.

PHOTO NO. 7 - View of rock slope protection on the upstream face of the dam.

PHOTO NO. 8 - View of rock slope protection on the downstream face of the dam.

PHOTO NO. 9 - View of embankment during construction.

PHOTO NO. 10 - View of borrow area during construction of the dam. (Embankment is shown on right hand side of photo.)

PHOTO NO. 11 - View of the emergency spillway looking upstream from the ridge located to the right of the spillway.

PHOTO NO. 12 - View of the emergency spillway looking downstream from the ridge located to the right of the spillway.

[illegible] View of the outfall channel (natural terrain) [illegible] the auxiliary spillway.

[illegible] View [illegible] the auxiliary spillway channel relative to the embankment.

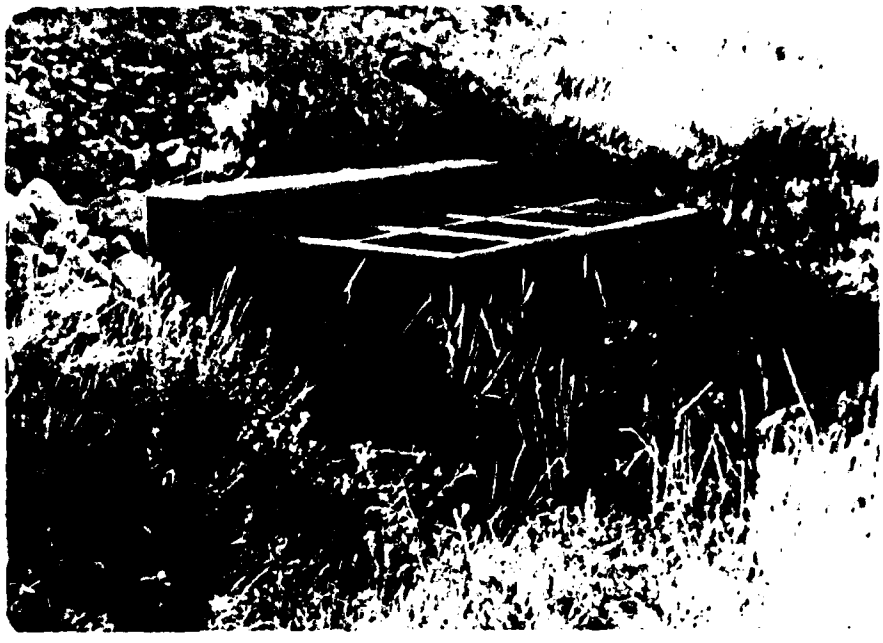


PHOTO NO. 16 - View of the conduit inlet headwall and trashrack structure.

PHOTO NO. 17 - View of the outfall channel below the downstream terminus of the conduit.

Photo No. 18 - View of [illegible] location of [illegible] conduits.

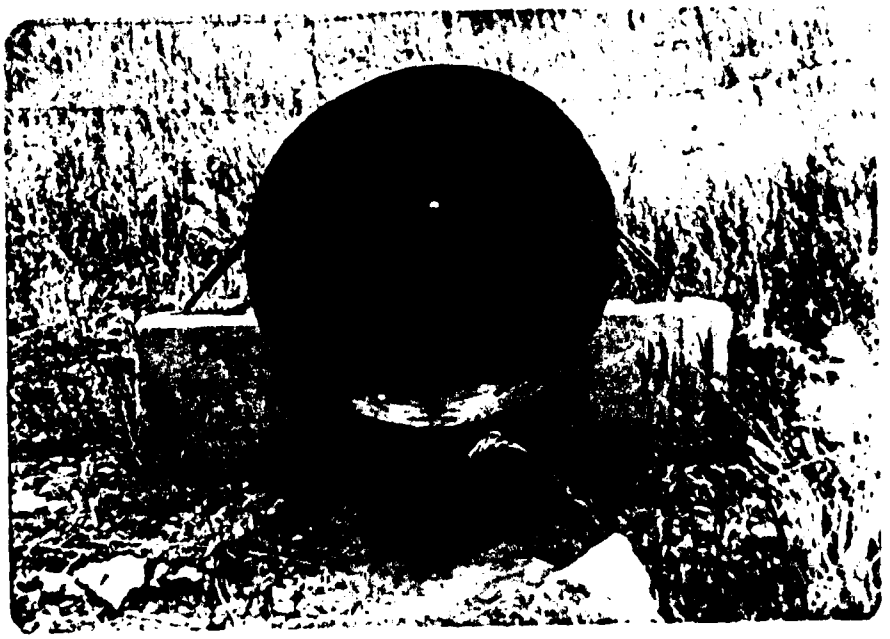


Photo No. 19 - View [illegible] reservoir area.

EN

DAT

FILME

8 - 8

DTI